CHAPTER 13

UNDERGROUND STORAGE TANK REMOVAL PROCEDURES

13-1. General. This chapter recommends procedures for the removal, storage, and offsite disposal of UST systems that have contained flammable or combustible fluids. All such work must be accomplished in accordance with federal, state, and local requirements as well as accepted safety standards. Before initiating work, the appropriate government agencies should be consulted concerning applicable regulatory and permit requirements. *This chapter is not considered to be all inclusive due to the differences in state regulatory requirements*. USACE Guide Specifications and other helpful guidance references are included in Chapter 1.

13-2. Removal of Underground Tanks.

a. Preparation.

(1) Observe the safety precautions as described in Chapter 7.

(2) Notify the Implementing Agency a minimum of 30 days prior to tank removal. Obtain a tank removal permit from the local fire chief or proper authorities and notify the environmental coordinator of the day and time when work will begin at least 3 days in advance. Typically, local regulations require a local fire official representative to be onsite before work may begin. Notify proper fire authorities as they require.

(3) Remove all liquids from the tank following the procedures outlined in Chapter 12.

b. Purging Tanks. Purging or ventilating a tank replaces or dilutes the flammable vapors in the tank with air. The goal of tank purging is to reduce the flammable vapors in the tank to below one percent of the LEL. Tanks shall be purged for confined space entry but not for removal purposes. However, it is important to recognize that the tank may continue to be a source of flammable vapors even after following the purging procedures.

Confined space entry into the tanks should not be attempted unless absolutely necessary, but it may be required to effectively remove sludge from the tank. Consult NFPA 326, *Safe Entry into Underground Storage Tanks,* for tank entry and Table 13-1, which summarize the procedures for tank purging as well as associated advantages and disadvantages.

TABLE 13-1
PROCEDURES FOR PURGING TANKS

Procedure	Advantage	Disadvantage
• Venting vapors This must be done at least 3.7 m (12 feet) above grade and 1 m (3 feet) above roof lines.	• Ventilation is usually the first method of choice for removing flammable atmospheres since it can be accomplished with the least cost.	• The work area must be free from sources of ignition. • All venting of flammable vapors must be into a safe location and should be monitored to ensure that a vapor buildup does not occur. • Ventilation must be ongoing to maintain flammable vapors below 10 percent LEL. • It may not be possible to adequately ventilate a tank that contains residuals of highly flammable liquids or sludge. • Venting without forced flammable vapor removal will not work unless the access to the tank is located on the top of the tank. • Venting is time consuming. • Purging is a temporary procedure. Product trapped in bottom sludge and wall scale regenerates flammable vapors inside the tank. • Venting cannot be used for tank removal purposes.

TABLE 13-1 (continued)
PROCEDURES FOR PURGING TANKS

Procedure	Advantage	Disadvantage
• Ventilation via an eductor-type air mover usually driven by compressed air	• Tanks equipped with fill (drop) tubes that are not removable can be purged efficiently by this method.	• Vapors must be discharged at a minimum of 3.7 m (12 feet) above grade. • All precautions must be taken to minimize the hazards of ignitability and static electricity. Air movers must be inherently bonded to the vessel being ventilated. • Exhaust fumes will need to be vented at a minimum height of 3.7 m (12 feet) above grade and 1 m (3 feet) above any adjacent rooflines. • To avoid rupturing the tank, air pressure in the tank must not exceed 34.5 KPa (5 psi) so the size of vent openings as well as the air pumping rate must be considered.

TABLE 13-1 (continued)
PROCEDURES FOR PURGING TANKS

Procedure	Advantage	Disadvantage
• Ventilation via a diffused air blower	• Generally, blowing into the tank rather than exhausting from the tank is more effective. • Ventilation via diffused air blower is relatively inexpensive.	• Irregular-shaped containers may not be thoroughly purged by this method if the airstream leaves pockets that cannot be effectively reached with the uncon-taminated air. • All precautions must be taken to minimize the hazards of ignition by static electricity. Air movers must be inherently bonded to the vessel being ventilated. • Fill (drop) tubes must be removed to allow proper diffusion of the air in the tank. • Air supply must come from a compressor that has been checked to ensure a clean air supply that is free from volatile vapors. • To avoid rupturing the tank, air pressure in the tank must not exceed 34.5 KPa (5 psi). • Exhaust fumes will need to be vented at a minimum height of 3.7 m (12 feet) above grade and 1 m (3 feet) above any adjacent rooflines.

TABLE 13-1 (continued)
PROCEDURES FOR PURGING TANKS

Procedure	Advantage	Disadvantage
• Use of commercial emulsifiers	• Completely miscible in water. • Aids in the elimination of flammable vapors. • Biodegradable.	• Regulatory requirements for treatment and disposal of the water must be determined. • Biosolve is an expensive material to purchase.
• Displacement of vapors with water	• One of the safest and simplest methods.	• Regulatory requirements for treatment/disposal of water used in the vapor-freeing process may make this method cost-prohibitive. • The liquid previously contained in the tank must be readily displaced by or be soluble in water. • In accordance with USACE guide specifications, purging methods utilizing liquids shall not be allowed.

(1) Exhaust flammable vapors from the tank by one of two methods of tank ventilation listed below.

(a) One method is ventilation using an eductor-type air mover, usually driven by compressed air. However, the USACE does not approve this method. Therefore, it is presented in this manual only for completeness of information. The eductor-type air mover must be properly bonded to prevent the generation and discharge of static electricity. When using this method, the fill (drop) tube should remain in place to ensure ventilation at the bottom of the tank. Tanks equipped with fill (drop) tubes that are not removable are purged by this method. An eductor extension is used to discharge vapors a minimum of 3.7 meters (12 feet) above grade or 1 meter (3 feet) above adjacent roof lines, whichever is greater.

(b) Ventilation with a diffused air blower is a second method. When using this purging method, it is imperative that the air-diffusing pipe is properly bonded to prevent the discharge of a spark. Fill (drop) tubes must be removed to allow proper diffusion of the air in the tank. Air supply should be from a compressor that has been checked to ensure a clean air supply that is free from volatile vapors. Air pressure in the tank must not exceed 34.5 KPa (5 psi) gauge to avoid tank failure.

(2) One of the safest and simplest methods for purging a tank is to fill the tank with water. However, in certain areas, regulatory requirements for treatment/disposal of water used in the vapor-freeing process may make this method cost-prohibitive. Purging methods using liquids will not be used on USACE projects due to generation of excessive volumes of waste. *The method is presented here for completeness*. Before employing the method described below, consult local regulations.

(a) Fill the tank with water until the floating product nears the fill opening. Remove the floating product and place it in a suitable container for proper disposal. Care should be exercised to ensure that neither product nor water is spilled into the tank excavation.

(b) Observe normal safety precautions filling the tank with water because flammable vapors will be expelled through both the vent and fill openings, but primarily at the fill opening. To minimize this escape of vapor through the fill opening, temporarily cap the opening.

(c) Pump out the water and dispose of it in accordance with local regulations when the tank is free of vapor.

(3) Another purging method that has been used with success and is an approved method in some states is the use of commercial emulsifiers and volatile fuel encapsulators. These products are completely miscible in water, aid in the elimination of flammable vapors, and are biodegradable. Regulatory requirements for treatment and disposal of the water must be determined prior to using this method.

(a) Standing outside the tank, rinse the tank with a three- to six- percent solution of the product using a pressure sprayer through a manway opening.

(b) Measure explosive concentrations at several levels within the tank. If readings are greater than 20 percent of the LEL, rinse the tank again.

(c) When LEL readings are acceptable, pump out the water in the tank for disposal.

c. Inerting Tanks. Inerting displaces the flammable atmosphere of the tank with an inert or nonreactive gas such as nitrogen or carbon dioxide. Inerting is achieved when the oxygen content is lowered to below 8 percent oxygen by volume, which is the amount of oxygen needed by most petroleum products to support combustion. Table 13-2 summarizes the procedures and advantages/disadvantages for tank inerting. Inerting is the only option available when removing tanks from the ground.

Always exercise caution when handling or working around tanks that have stored flammable or combustible liquids. Before initiating work in the tank area or on the tank, a Combustible Gas Indicator (CGI) should be used to assess vapor concentrations in the tank and work area. CGI operation is detailed in Chapter 10.

TABLE 13-2
PROCEDURES FOR INERTING TANKS

Procedure	Advantage	Disadvantage
• Displacement of vapors with dry ice, carbon dioxide gas	• When inerting with dry ice, the static electrical problems that are encountered with gas cylinder inerting are not encountered. • Dry ice is readily available and relatively inexpensive.	• This method cannot be used if the tank is to be entered for any reason as the tank atmosphere will be oxygen-deficient. • The dry ice vaporization releases flammable vapors. • Exhaust fumes from inerting should be vented at a minimum height of 3.7 m (12 feet) above grade and 1 m (3 feet) above any adjacent roof lines. • Air pressure in the tank must not exceed 34.5 KPa (5 psi) gauge. • There is no momentum for vapors in the tank to move toward the vent so inerting takes longer and may be less effective than inerting with compressed gas. • Pockets of vapors can be trapped in the tank if distribution of the inert gas in the tank is incomplete. • Oxygen may be re-introduced into the tank unless all holes are effectively plugged, except for the vent line.

TABLE 13-2 (continued)
PROCEDURES FOR INERTING TANKS

Procedure	Advantage	Disadvantage
• Inerting with an inert gas such as CO_2 or N_2 The concentration of oxygen in the tank can be reduced to a level insufficient to support combustion by replacing the oxygen with an inert gas. CO_2 is generally the gas of choice since its density is greater than air causing it to settle to the tank bottom pushing oxygen up and out of the tank.	• Inert gases may be used to remove the flammable vapors from containers under certain conditions without the hazards incidental to having the vapor-air mixture in the tank space pass through the flammable range. • Inerting with CO_2 or nitrogen from cylinders is generally faster than dry ice due to better distribution of the inert gas. • Inerting can be completed in a short period of time.	• This method cannot be utilized if the tank is to be entered for any reason, as the tank atmosphere will be oxygen-deficient. • The gas must be introduced through a single tank opening and under low pressure < 34.5 KPa (5 psi). • Compressed gases may create a potential ignition hazard as the result of the development of static electrical charges. The discharge device must, therefore, be grounded. • Exhaust fumes from inerting should be vented at a minimum height of 3.7 m (12 feet) above grade and 1 m (3 feet) above any adjacent roof lines. • Inerting with gas can be expensive. • Compressed CO_2 has a much larger temperature difference with the outside atmosphere than bottled nitrogen. This difference leads to condensation, which increases the generation of static electricity. • Oxygen may be re-introduced into the tank unless all holes are completely plugged, except for the vent line.

(1) Flammable and combustible vapors may be inerted with an inert gas such as CO_2 or N_2. This method should not be utilized if the tank is to be entered for any reason, as the tank atmosphere will be oxygen deficient. The inert gas should be introduced through a single tank opening at a point near the bottom of the tank, at the end of the tank opposite the vent. If necessary, excavate around the vicinity of the tank to access the connection. When inert gases are used, they should be introduced under low pressure to avoid the generation of static electricity. When using CO_2 or N_2, pressures in the tank should not exceed 5 psi gauge. The process of introducing compressed gases into the tank may create a potential ignition hazard as the result of the development of static electrical charges. The discharging device must, therefore, be grounded. CO_2 extinguishers should not be used for inerting flammable atmospheres because explosions have resulted from the discharging of CO_2 fire extinguishers into tanks containing a flammable vapor-air mixture.

(2) If the method described above is not practical, the vapors in the tank may be displaced by adding solid carbon dioxide (dry ice) to the tank in the amount of at least 1.36 Kg (3 pounds) per 378 liters(100 gallons) of tank capacity. The dry ice should be crushed and distributed evenly over the greatest possible area in the tank to promote rapid evaporation. As the dry ice vaporizes, flammable vapors will flow out of the tank and may surround the area. Therefore, where practical, plug all tank openings except the vent after introducing the solid CO_2 and continue to observe all normal safety precautions regarding flammable or combustible vapors.

(3) Monitoring of oxygen concentrations within the tank should be done during the inerting operation. Inerting has been satisfactorily accomplished when the oxygen content is less than 8 percent. If vapor reduction is not occurring satisfactorily and the onsite official allows, pour water down each pipe to which dry ice was added. This will distribute the dry ice and release more CO_2. If vapor reduction is not adequate after the above procedures have been followed, repeat dry ice application using half of the original dry ice quantity per volume.

d. Testing.

(1) The tank atmosphere and the excavation area should be continuously tested for percent oxygen and combustible gas during the tank excavation and removal operations. Follow these guidelines to test:

(a) Take such tests with a CGI with an oxygen meter that is properly calibrated according to the manufacturer's instructions (typically on pentane or hexane in air) and which is thoroughly checked and maintained in accordance with the manufacturer's instructions.

(b) Use a person completely familiar with the use of the instrument and the interpretation of the instrument's readings to do the test.

(c) Take readings at the bottom, middle, and upper portions of the tank and clear the instrument after each reading. If the tank is equipped with a nonremovable fill tube, readings should be taken through another opening.

(2) Follow these procedures to ensure the tanks remain properly inerted:

(a) Test the tank vapor space by placing the indicator probe into the fill opening with the drop tube removed. Liquid product must not enter the probe.

(b) Readings of less than 8 percent oxygen must be obtained before the tank is considered safe for removal from the ground. Oxygen readings that rise above 8 percent during removal activities will require additional tank inerting before removal activites can continue.

e. Associated Piping Inerting. In preparation for tank removal, the type of tank appurtenances must be evaluated. Different types of tank configurations include those with removable extractor valves, angle check valves, nonextractor angle check valves, direct connect lines, and other connecting lines. Remove any check valves to prevent backflushing of the pipe lines. All piping must be inerted before tank removal begins. These lines may have a manhole that

allows access from the surface without excavation, or excavation may be required for access. Confined space precautions will be followed if employees are required to enter tanks, manholes, or excavations.

(1) Removable Extractor Valves. Procedures for inerting different types of tank configurations are discussed first followed by procedures common to all.

(a) Access tank connections via manhole or by excavation.

(b) Remove each extractor valve riser cap and remove the extractor valve using the proper tool.

(c) Recap and tighten each extractor valve riser cap.

(2) Nonextractor Angle Check Valves, Direct Connections and Other Connecting Lines.

(a) Access connections via manhole or by excavation.

(b) Inert all piping before tank removal begins.

(c) Disconnect the fuel line from the angle check valve and disconnect other lines from the tank.

(d) Catch any liquids from the lines in a container and properly dispose of liquids.

(e) Attach a reducing bell to the suction or connecting line to reduce the line diameter to 20 mm (3/4-inch).

(f) Remove angle check valve or appurtenance from the tank, if possible.

(g) Attach a 20 mm (3/4-inch) gasoline-rated hose to the 20 mm (3/4-inch) end of the bell reducer and insert the free end of the hose into the nearest bung opening in the tank.

(3) Common Pipe Inerting Procedures. Use N_2 or CO_2 for the following steps.

(a) Disconnect the piping at the dispenser or building.

(b) Make connections such that the piping system may be backflushed with the selected inert substance.

(c) Pressurize the line with the substance so that the fluid in the pipeline will be backflushed into the UST. If the tank connections are of the extractor-valve type, repeat the backflushing process with each line that is connected to the UST. If the lines are of the direct-connect type, continue until the hose discharge is observed to be exhausting clean inert substance. The procedures must be repeated for each additional line.

f. Tank Removal.

(1) Remove liquids and residues from the tank as detailed in Chapter 12.

(2) If excavation has not already been performed for piping access, remove concrete or asphalt cover. Excavate underlying soils down to the top of the tank. Segregate these soils from those underlying the tank to reduce disposal volumes if these upper soils have no visual or odor contamination. Excavation should be deep and wide enough to allow access to all associated piping and appurtenance tank connections.

(3) Remove the fill pipe, gauge pipe, vapor recovery truck connection, submersible pumps, and other tank fixtures. Remove the drop tube, except when it is planned to purge the tank by using an eductor as described previously. Cap or remove all nonproduct lines, such as vapor recovery lines, except the vent line. The vent line should remain connected until the tank is purged. Temporarily plug all other tank openings so that all vapors will exit through the vent line during the inerting process.

(4) After the tank has been inerted and before it is removed from the excavation, cap or plug all pipes or bungs at or as near as possible to the tank. Cut any tank hold-down straps. Use a nonsparking cutter, such as pipe cutters, to avoid the generation of any sparks during pipe cutting.

The plug or cap sealing the vent tube must have a 3-mm (1/8-inch) hole drilled through the tube. This hole will allow expansion and contraction of the gases contained within the tank due to temperature variations without subjecting the tank to excessive differential pressure caused by temperature changes. The tank should always be positioned with this vent plug on top of the tank during subsequent transport and storage.

(5) To remove the tank:

(a) Attach pulling chain to the tank eyelets or any secure hooks or rungs, or use nylon slings that will support the tank weight.

(b) Remove tank from excavation, using appropriate lifting device in accordance with requirements of EM 385-1-1. Front-end loaders and backhoes cannot be used for lifting unless they are equipped with a factory attached hook designed with adequate lift capacity for the tank, and the tank does not exceed the published lifting capacity for the equipment.

(c) Set tank on the ground and stabilize with wooden blocks. Keep the ventilation cap with the 3-mm (1/8-inch) hole on top.

(6) Visually inspect the outside of the tank and use screwed (boiler) plugs to plug any and all corrosion holes in the tank shell.

(7) Recheck the oxygen content within the tank as before and reinitiate inerting procedures, if required. It is vital that the internal tank atmosphere be insufficient to support ignition as sparks are possible, and a tank above ground can cause great damage to life and property if ignition occurs.

(8) Remove external scale and attached soil from the tank. *Nonsparking tools must be used at all times in the vicinity of the tank until such time as the tank interior and exterior surfaces are decontaminated*.

(9) See Chapter 15 (Soil and Free-Product Removal Procedures) for further excavation procedures concerning soil samples and contamination soil excavation.

(10) Contain spills or drips during removal using absorbent booms or other methods required by the Implementing Agency. If you observe contamination (i.e., saturated soil or free product) from previous operation or removal, consult local environmental officials, the fire marshal, or the EPA for assistance and requirements. See API Bulletin 1628 for further information.

g. Sludge Removal. Remove sludge and decontaminate the interior and exterior of the tank prior to tank removal from the work site. The contractor should submit in the SSHP plans and procedures, including materials and supplies, for safely and effectively opening the tanks, cleaning all surfaces of the interior of the tanks, and disposing of the sludge and decontamination fluids.

Restrictions include the following:

(1) No volatile organic solvents should be permitted for decontamination procedures.

(2) The Implementing Agency must be consulted to determine if any requirements exist for determining when the tank is considered clean.

(3) No personnel should be permitted to enter any of the storage tanks at any time except by following the confined space guidelines as provided in Appendix E of this manual or unless the tank ends have been removed.

Refer to Chapter 14 for sludge removal and tank cleaning procedures. Collect and dispose of decontamination fluids as outlined in Chapter 9.

h. Free-Product Removal. Many times during tank removals, the excavation area fills up with free product and/or water. Remove this product and water prior to tank removal or soil excavation. Refer to Chapter 5 for installation of monitoring wells in free product, Chapter 6 for sampling free product, and Chapter 15 for free product procedures.

i. Tank Ballast Pads. Concrete ballast pads and associated hold down straps are installed to counteract buoyant forces in high groundwater areas. Ballast pads are difficult and expensive to remove. Concrete ballast pads may be left in place under most circumstances unless significant contamination is present and it cannot be remediated by in-situ methods, or the user requires the pads removal.

13-3. Tank Disposal.

a. Tank Storage.

(1) Label tanks if they will be stored prior to disposal. Label after removal from the ground but prior to removal from the site.

Label requirements include the following:

(a) Regardless of the condition of the tank, the label should contain a warning against certain types of reuse.

(b) The former contents and present vapor state of each tank, including vapor-freeing treatment and date should be indicated.

(c) The label should be similar to the following in legible letters at least two (2) inches high:

TANK HAS CONTAINED LEADED GASOLINE*
NOT VAPOR FREE
NOT SUITABLE FOR STORAGE OF FOOD OR
LIQUIDS INTENDED FOR HUMAN OR ANIMAL
CONSUMPTION
DATE OF REMOVAL: MONTH/DAY/YEAR

*Or other flammable/combustible liquid. Use the applicable designation, for example, DIESEL.

(2) Tanks that have held leaded motor fuels (or whose service history is unknown) should also be clearly labeled with the following information (see API Publication 2015A for additional guidelines):

TANK HAS CONTAINED LEADED GASOLINE
LEAD VAPORS MAY BE RELEASED IF HEAT
IS APPLIED TO THE TANK SHELL

(3) Remove tanks from the excavation site as promptly as possible after vapor-freeing and sludge removal procedures have been completed, preferably on the day of tank removal from the excavation. If a tank remains at the excavation site overnight or longer, additional vapor may be released from any liquid absorbed in the tank walls or residues remaining in the tank.

(4) Decontaminate the tank as indicated in Paragraph 13-2e and Chapter 14 prior to removal from the excavation site. Check with a CGI to ensure that the LEL does not exceed 10 percent of the LEL and the oxygen content of the tank atmosphere is not greater than 8 percent.

(5) Secure the tank on a truck for transportation to the storage or disposal site with the 1/8-inch vent hole located at the uppermost point on the tank. Tanks should be transported in accordance with all applicable federal, state, and local regulations.

(6) Store tanks in secured areas on the premises of persons familiar with any attendant hazards and where the general public will not have access. A fenced yard, separate from other facilities, is preferred.

b. Disposal Criteria.

(1) Tanks should not be reused. Whether sold to a scrap dealer or disposed of at an approved facility, tanks must be cut into small pieces smaller than $1.5 m^2$ ($16 ft^2$). The dissection can occur at the excavation site, at a centrally located contractor staging area, or at a licensed tank decommissioning/disposal facility. The contractor should submit the dissection method and location as part of the work plan.

(2) Tanks that have been lined internally or coated externally with epoxy-based or similar materials may not be accepted by scrap

processors. Prior inquiries should be made as to the requirements of the scrap processor.

c. Disposal Procedures.

(1) After a tank has been vapor-freed, render it unsuitable for future use as a storage tank by puncturing or cutting with nonspark-producing methods. The USACE-recommended practice is cutting tanks into sections no larger than 1.5 m^2 (16 ft^2). Recycle or landfill only if scrap processors refuse to accept the tank sections.

(2) Assign all tanks a unique identifier for all records and reporting.

(3) Use a bill of sale to transfer tank ownership. This bill of sale should be submitted with the Tank Closure Report discussed in Chapter 1.

(4) Consult current federal, state, and local regulations prior to disposal to determine if special procedures or preparations are required.

(5) Physically clean metal tanks that are going to be sold as scrap metal after they are inerted and cut open. Cleaning can consist of high pressure or steam rinse, triple rinse, or scraping/scrubbing. Methods are detailed in Chapter 14.

13-4. Waste Disposal and Recycling. Free product, sludge, and rinse waters are typical wastes generated during tank removal. Federal, state, and local requirements must be followed for proper disposal. Options for managing wastes generated during tank removal will be similar to those discussed in section 12-4 regarding tank contents.

13-5. Tank Coating Issues. The exterior of metal USTs are frequently coated with coal-tar type coatings. Historical data indicates that the coating materials occasionally contain hazardous substances such as asbestos, polychlorinated biphenyls, lead, and cadmium. The presence of PCBs and asbestos make it difficult to recycle the tanks as scrap metal. If the coating contains PCBs and/or asbestos that cannot be easily removed because of regulatory constraints or safety issues, it may be more cost effective to dispose of the tanks within a chemical waste landfill.